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STUDIES ON GENETIC DIVERGENCE IN CHILLI

(*CAPSICUM ANNUUM* VAR. *ANNUUM* L.)

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ABSTRACT

A study on genetic diversity in 74 genotypes of chilli for various characters revealed substantial differences for all the characters. The accessions were grouped into seven clusters with maximum number of genotypes in cluster V with thirty three genotypes followed by cluster-VII with twenty seven genotypes, cluster IV with five genotypes and cluster I, II, III and VI with two genotypes each. Maximum intra cluster distance (228.90) was observed in cluster-VII followed by cluster-IV (205.06) and cluster-V (191.05) which suggested appreciable genetic diversity within particular cluster. The minimum inter cluster divergence was noticed between cluster II and VI (113.33), followed by cluster II and III (123.38), cluster III and VI (124.36) and they seemed to be closely related as compared to other pairs of clusters. The maximum inter cluster distance was observed between cluster- II and IV (292.86), followed by cluster IV and V (266.67), cluster IV and VII (266.24). Intercrossing among the genotypes belonging to cluster-I, II, IV and V was suggested to develop high yielding genotypes with desirable characters viz., Plant height, number of branches per plant, days to flowering, fresh fruit weight, fruit length, fruit girth, number of fruits per plant, number of seed per pod, capsaicin, oleoresin, fresh pod yield per plant and dry pod yield per plant.

KEYWORDS: Capsicum annuum var. annuum, Genetic Divergence, Breeding Potential, D^2 Statistics & Horticultural Traits

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INTRODUCTION

Chilli (Capsicum *annuum* var. *annuum* L.) is one of the important commercially grown vegetable cum spice crop in almost all parts of tropical and subtropical regions of the world. Chilli is mainly used for its pungency, colour and flavor. Consumption of small amount of chilli enriches diet with considerable quantity of minerals, vitamins and other food components. It is probably introduced by Portuguese into southern parts of India and cultivation spread out throughout India by the end of 19th century. In plant breeding, genetic diversity plays a very important role as it helps in selecting the suitable parents for hybridization programme resulting in superior hybrids and desirable recombinants. Genetic divergence is a basic requirement for effective selection within the existing population arising out of hybridization. Mahalanobis's D^2 statistic of multivariate analysis is recognized as a powerful tool in quantifying the degree of genetic divergence among the populations. Keeping in view the above facts present investigation was undertaken to work out genetic divergence among seventy four genotypes based on important traits of chilli, to help the breeders in selecting promising and genetically diverse parents for desired improvement.

MATERIALS AND METHODS

The present investigation was carried out in the farmers field at Virudhunagar district of Tamil Nadu during, monsoon season of 2013-2014. The experimental materials comprised of seventy four accessions of chilli collected from different parts of Tamil Nadu and Southern India. The experiment was laid out in a randomized block design with two replications. Seeds sown in filled portrays and 45 days old seedlings were transplanted into the main field with spacing of 60 x 45 cm were maintained and all the recommended agronomic package of practices along with plant protection measures were followed. Five plants were selected randomly for recording the observations on twenty nine characters *viz.*, growth characters (plant height, number of primary branches per plant, days to flowering, days to fifty per cent flowering, root length, root volume), biochemical characters (chlorophyll a, chlorophyll b, total chlorophyll, chlorophyll stability index, relative water content, soluble protein, total phenol, proline, nitrate reductase activity, IAA oxidase activity, catalase activity), yield characters (number of pods per plant, fruit length, fruit girth, fresh pod weight, dry pod weight, number of seed per pod, thousand seed weight, fresh and dry pod yield per plant) and quality characters (capsaicin, oleoresin, ascorbic acid content. Assessment of genetic diversity in classifying the chilli genotypes into different clusters was done by adopting the method of Mahalanobis's D^2 analysis. (Mahalanobis, 1936).

RESULTS AND DISCUSSIONS

On the basis of magnitude relative of D^2 values, seventy four chilli genotypes were grouped into seven divergent clusters (Table 1) (Varalakshmi and Hari Babu, 1991 and Sreelathkumary and Rajamony, 2004). The cluster V had maximum number of genotypes with thirty three followed by cluster VII with twenty seven genotypes, cluster IV with five genotypes and cluster I, II, III and VI with two genotypes each.

Intra and inter cluster average D^2 values are presented in Table 2. Maximum intra cluster distance (228.90) was observed in cluster-VII followed by cluster-IV (205.06) and cluster-V (191.05), which suggested availability of appreciable genetic diversity within particular clusters. The minimum inter cluster divergence was noticed between cluster II and VI (113.33), followed by cluster II and III (123.38), cluster III and VI (124.36) and they seemed to be closely related as compared to other pairs of clusters. The maximum inter cluster distance was observed between cluster- II and IV (292.86), followed by cluster IV and V (266.67), cluster IV and VII (266.24). The distance between the cluster III and V (151.37) followed by cluster V and VI (170.19) was moderate. The genotypes included in these clusters could be used as parents in hybridization programme to get higher heterotic hybrids from the segregating population.

As to crosses among divergent parents would likely to yield desirable recombinants, a breeding programme could be initiated between the selected genotypes belonging to different clusters considering their cluster means (Table 3). The genotypes in cluster-I exhibited superiority with highest plant height (90.74 cm) and the highest number of branches per plant (6.20) followed by cluster V (73.62 cm and 3.76) and IV (66.53 cm and 4.00). Similarly, the cluster-I showed highest mean values for root length (15.97 cm), root volume (31.20 cc), chlorophyll content (2.22 mg/g), soluble protein (13.65 mg/g), total phenol (3.03 mg/g), and IAA oxidase activity (345.5 µg of un oxidised auxin $g^{-1} hr^{-1}$). Cluster-VI (73.30) recorded highest cholorophyll stability index which proved their performance of stress tolerance activity. The chilli cultivation at the Viruthunagar district of Tamil Nadu, is a place of peculiar environment which really dependent on monsoon rains only. Further, the cluster – IV also showed the highest mean values for relative water content (72.29 per cent) and proline content (383.11 per cent) followed by cluster –III showed the highest mean values for nitrate reductase activity (135.65 µmol NO_2 g^{-1} h^{-1}) and catalase activity (15.25 µg H_2O_2 g^{-1} min^{-1}). The genotypes could also

utilized as parents to develop by breeding of varieties against stress tolerance *i.e.*, drought tolerance.

The cluster means for number of fruits per plant was the highest for cluster-IV (119.11) followed by cluster-I (106.98). The cluster-II exhibited the highest mean value for fresh (5.45g) and dry pod weight (0.95g). The cluster-II recorded highest fruit length (10.80 cm) followed by cluster-III (9.77 cm) and cluster-I (9.70 cm). The cluster means for fruit girth was the highest in cluster-VI (4.66 cm) followed by cluster-II (3.85 cm) and cluster-I (3.83 cm). For chilli exporter in Virudhunagar district, prefer the fruits of samba type *ie*., long ones with considerable fruit girth. The cluster-I recorded highest number of seeds per pod (83.50) followed by cluster-II (71.10) and cluster-V (70.56). The highest cluster mean for thousand seed weight was observed in cluster-III (7.47 g per pod) followed by cluster-V (7.38 g per pod) and cluster-I (7.07 g per pod). The cluster-IV recorded the highest fresh pod yield per plant (419.30 g per plant) and dry pod yield per plant (82.90 g per plant). The quality trait *viz.,* capsaicin content was observed to be the highest in cluster-IV (0.35 per cent) and oleoresin content was also observed to the highest in cluster-IV (8.61 per cent) followed by cluster-I (8.24 per cent). The highest mean performance for ascorbic acid was observed to be highest in cluster-I (124.9 mg per 100 g) followed by cluster-V (110.15 mg per 100 g).

On the basis of present study it could be concluded that yield per plant, fruit number per plant, number of seeds per pod, thousand seed weight, oleoresin and capsaicin contents were the most important quantitative and qualitative characters to be taken into consideration for effective selection in chilli. Breeding programme aiming for high pod yield, the chilli genotypes from cluster IV could be selected as parents showing the highest mean yield per plant coupled with quality traits. To breed long dry pod chilli varieties having some demand in specific regional selection for chilli accessions exports from cluster-II would be useful. In general, the cluster-I and IV were observed to be superior for one or other characters of the study. The genotypes of highly divergent cluster could also be utilized in breeding programme for development of high yielding F_1 hybrids with desirable attributes of yield and quality characters.

CONCLUSIONS

Genotypes in the cluster IV proved its superior performance in respect to number of fruits per plant, fresh and dry pod yield per plant, quality traits *viz.*, capsaicin and oleoresin content apart from physiological parameters *viz.*, proline content, relative water content and chlorophyll b content which provides stress tolerance ability to check genotypes. The genotypes in cluster-I also exhibited superiority for the traits *viz.*, plant height, number of branches, root length, root volume, chlorophyll a, total chlorophyll, soluble protein, total phenol, IAA oxidase activity.

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APPENDICES

Table 1: Clustering Pattern of 74 Genotypes of Chilli Based on D^2 Analysis

Clusters	Number of Genotypes	Name of the Genotypes
I	2	Villathikulam Local and Aladipatti Local
II	2	VI0 46853 and VI037597
III	2	Samypatti Local and Surandai Local
IV	5	China, KKM 1, Arka Lohit, AVPP0906 and VI046979
V	33	K1, Arka Suphal, Kashi Anmol, Kashi Surkh, Guntur Badagi, Guntur Teja, Guntur NO5, Guntur 273, Guntur 341, Byadagi, Madhya Pradesh Local, Virusampatti Local, Perayur Local, Mettupatti Local, Serndhakottai Local, Vallayapookulam Local, Arianachiapuram Local, Punavasal Local, Vallakulam Local, Thoppudapatti Local, Nerinjipatti Local, Kodangipatti Local, Arasakulam Local, Mavilpatti Local, Pothanadhi Local, Amarnadu Local, IC-214990, IC-505242, IC-526858, IC-526862, IC-526856, VI041283 and VI059328
VI	2	AVPP0813 and AVPP0904
VII	28	Sathur Local, IC-570388, EC-339044, EC-378695, EC-391082, AVPP1127, AVPP1128, AVPP0514, AVPP0713, AVPP0715, AVPP0716, AVPP0717, AVPP0718, AVPP0721, AVPP0905, AVPP9905, VI041282, VI037438, VI037522, VI037538, VI037603, VI037599, VI0556, VI047003, VI060885, VI039358, VI037449, VI046903

Table 2: Average Intra (Bold) and Inter Cluster D^2 Values for Seven Clusters in 74 Chilli Genotypes

Clusters	I	II	III	IV	V	VI	VII
I	**3968.6 (62.99)**	31769.1 (178.23)	29521.4 (171.81)	48116.6 (219.35)	32195.0 (179.43)	29899.4 (172.91)	50298.7 (224.27)
II		**4191.24 (64.74)**	15224.5 (123.38)	85771.8 (292.86)	27760.8 (166.61)	12844.3 (113.33)	41757.9 (204.34)
III			**4402.15 (66.34)**	64828.2 (254.61)	22915.2 (151.37)	15467.6 (124.36)	34200.0 (184.93)
IV				**42052.6 (205.06)**	71646.1 (267.66)	58249.4 (241.34)	70888.6 (266.24)
V					**36502.9 (191.05)**	28967.1 (170.19)	48785.6 (220.87)
VI						**6215.66 (78.83)**	31518.2 (177.53)
VII							**52404.2 (228.9)**

Table 3: Cluster Mean for Yield and Quality Traits in 74 Genotypes of Chilli

Traits \ Cluster	I	II	III	IV	V	VI	VII
Plant height (cm)	90.74	54.73	62.19	66.53	73.62	54.29	56.
98Number of branches per plant	6.20	2.00	3.00	4.00	3.76	3.44	3.27
Days to flowering	86.29	94.57	83.72	85.84	87.80	91.47	93.16
Days to fifty per cent flowering	92.84	98.80	89.39	91.41	93.70	97.32	98.61
Root length (cm)	15.97	12.34	13.50	12.93	13.94	11.11	10.37
Root volume (cc)	31.20	23.91	23.42	26.12	26.31	14.72	20.56
Chlorophyll ‘a’ (mg/g)	1.30	0.99	1.15	1.17	1.08	0.79	0.88
Chlorophyll ‘b’ (mg/g)	0.57	0.42	0.48	0.59	0.49	0.31	0.40
Total chlorophyll (mg/g)	2.22	1.40	1.69	1.82	1.63	1.16	1.34
Chlorophyll stability index (Per cent)	71.20	54.55	68.80	72.73	69.69	73.30	60.86

Table 3: Contd.,							
Relative water content (Per cent)	70.70	60.94	67.97	72.29	68.64	67.64	63.63
Soluble protein (mg/g)	13.65	7.77	11.00	11.94	12.26	7.65	9.05
Total phenol (mg/g)	3.03	2.22	2.54	2.58	2.57	2.76	2.29
Proline (µ moles g^{-1})	377.8	239.5	313.05	383.11	308.11	234.55	239.46
Nitrate reductase activity (µmol NO_2 g^{-1} h^{-1})	134.25	73.35	135.65	103.90	106.85	64.75	76.37
IAA unoxidase activity (µg of un oxidised auxin g^{-1} hr^{-1})	345.5	224.0	292.5	293.41	293.00	214.0	240.88
Catalase activity (µg H_2O_2 g^{-1} min^{-1})	15.12	13.01	15.25	13.73	13.68	10.70	11.75
Fresh fruit weight (g per pod)	3.80	5.45	3.08	3.99	3.64	4.40	3.79
Dry fruit weight (g per pod)	0.87	0.95	0.80	0.77	0.85	0.87	0.72
Fruit length (cm)	9.70	10.80	9.77	6.46	9.18	8.38	7.19
Fruit girth (cm)	3.83	3.85	3.73	3.78	3.72	4.66	3.24
Number of fruits per plant	106.98	47.10	70.09	119.11	74.74	55.99	51.98
Number of seed per pod	83.50	71.10	63.25	63.90	70.10	34.80	50.12
Thousand seed weight (g per pod)	7.07	6.37	7.47	6.31	7.38	4.55	5.50
Capsaicin (Per cent)	0.25	0.29	0.26	0.35	0.26	0.12	0.25
Oleoresin (Per cent)	8.24	6.62	6.56	8.61	7.09	7.37	6.66
Ascorbic acid (mg/100g)	124.9	90.78	105.12	100.68	110.15	83.12	91.98
Fresh pod yield per plant (g per plant)	404.47	256.05	216.68	419.30	256.78	237.32	179.33
Dry pod yield per plant (g per plant)	72.59	44.79	56.50	80.66	57.17	43.86	34.63